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REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., September 4, 1920.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1920.

Respectfully,

E. W. NELSON,
Chief of Bureau.

Hon. E. T. MEREDITH,
Secretary of Agriculture.

WORK OF THE BUREAU OF BIOLOGICAL SURVEY.

The activities of the Bureau of Biological Survey are conducted under four divisions: (1) Investigations of the food habits of North American birds and mammals in relation to agriculture, in charge of Dr. A. K. Fisher; (2) biological investigations, with special reference to the habits and geographic distribution of native animals and plants, in charge of E. A. Goldman; (3) supervision of national mammal and bird reservations, in charge of Dr. G. W. Field until December 6, 1919; in charge of H. F. Stone since July 1, 1920; (4) administration of the migratory-bird treaty act and enforcement of the Lacey Act regulating the importation of birds and wild mammals and the interstate shipment of game, in charge of George A. Lawyer.

From the time of the organization of the Biological Survey its main purpose has been to study the habits and distribution of our wild birds and mammals, to assist in the conservation of the beneficial and harmless species, and to devise practical methods for the control of those classed as injurious. The files of the bureau contain an unparalleled volume of information drawn from 35 years of field work of its experts in all parts of North America and from thousands of collaborators as well as from published sources.

During recent years appreciation of the value of our wild life has grown rapidly, and constantly increasing demands are voiced for the conservation of the useful and harmless forms. In this same time changing conditions due to increased occupation of the country have caused certain species both of birds and of mammals to become so seriously injurious to crops, forestry, and stock growing that it has become necessary to develop effective methods for controlling or destroying them on a large scale.

As a result, the demands from many directions for increased activities on the part of the bureau far exceed the possibilities of meeting them with the funds available. As in other branches of the Government, the bureau suffers from the loss of skilled employees due to larger salaries paid outside the service and from the necessity of paying higher prices for services and material.

ECONOMIC INVESTIGATIONS.

With the rising values of all food products and the urgency of increased production, the suppression of crop and stock destroying pests becomes increasingly important. At the time this work was launched on a large scale in 1917 it was estimated that injurious native rodents, as ground squirrels, prairie dogs, pocket gophers, jack rabbits, and field mice, each year destroyed crops and forage in the United States valued at approximately $300,000,000; house rats annually destroyed about $200,000,000 worth of food products and other property; while predatory animals were killing live stock having a value between $20,000,000 and $30,000,000. Recent investigations of some of the smaller rodents, as kangaroo rats, show that the myriads of these animals also, which are largely seed and root eaters, have a far greater destructive effect on both cultivated crops and native forage grasses than has been realized.

The Biological Survey has demonstrated the possibility of eliminating the larger part of these losses. The destruction of mammal pests has been so successful that farmers and stock growers of the West, where such losses are greatest, are increasing their demands upon the bureau for more extended work to a degree which becomes embarrassing, in view of the limited Federal funds available. The fact that the unoccupied lands of the public domain are the main harboring and breeding places of these pests makes the need for added funds more pressing, since private landowners undertake to destroy the pests on their holdings and ask that the Government destroy them on public lands adjoining.

The reduction of available funds by the discontinuance of the war emergency fund on June 30, 1919, together with a steady increase in the wages of men and in the cost of materials, has handicapped the bureau in its work. The amount of money being appropriated for cooperative undertakings by States, counties, associations, and individuals has rapidly increased until during the present year it has reached the sum of $1,114,000. This tangible evidence of appreciation of the practical value of the work is due to actual demonstration of increased forage and stock production on the ranges and of additional crop yields on farms through the elimination of mammal pests at a reasonable cost. A conservative estimate of the saving effected during the year from the campaign against rodents amounts to about $10,000,000, and from operations against predatory animals to about $6,000,000.

The predatory-animal and rodent-pest suppression work is definitely organized in 14 districts covering 18 States, the districts being in charge of inspectors with trained assistants cooperating with the States Relations Service, State and county officials, and community

organizations, as farm bureaus and stockmen's associations. The districts are as follows:

1. Washington.
2. Oregon.
3. Idaho.
4. Montana.
5. North and South Dakota.
6. Wyoming-Nebraska.
7. Colorado-Kansas.
8. Utah.
9. Nevada.
10. California.
11. Arizona.
12. New Mexico.
13. Oklahoma-Arkansas.
14. Texas.

As soon as funds are available it is planned to assist in the organization of cooperative campaigns against mammal pests in Iowa and Minnesota. Assistance in eliminating losses from rodents is being requested in many other States from the Mississippi Valley to the Atlantic coast.

PREDATORY ANIMALS.

A force of skilled hunters and trappers, varying from 300 to 400 in number, were employed under bureau supervision during the year to destroy predatory animals. A part of these men were paid by the Federal Government and a part by cooperating States, counties, livestock associations, and individuals. For this purpose $272,000 was expended by cooperators in Arizona, Colorado, Montana, North Dakota, Nevada, California, New Mexico, Oregon, Washington, Texas, Utah, and Wyoming. As heretofore, the skins taken by each hunter become the property of the organization or individual paying his salary. The numbers and kinds of skins taken by these hunters during the year were as follows:

Wolves	523
Coyotes	21,558
Mountain lions	189
Bobcats	2,987
Canada lynxes	10
Bears	94
Total	25,361

The skins taken by Federal hunters during the year sold for $42,048.80, making a total to date of $240,791.65 turned into the United States Treasury in connection with this work.

In addition, extended poisoning operations were conducted over great areas, especially in Wyoming, Utah, Nevada, Arizona, and New Mexico. Judging from the dead bodies found, the number of coyotes killed in this way was approximately the same as the total of all animals trapped. It has become evident that systematic poisoning operations on a large scale, employing modern methods under careful supervision, are a most economical and practical means of reducing the number of coyotes. Extended experiments have been conducted both at the Albuquerque, N. Mex., laboratory and on the ranges and forests. Good progress has been made in developing more effective poisons as well as improved methods of establishing stations and distributing poison for coyotes. These have been successfully applied in organized cooperative campaigns.

In many large grazing ranges, mainly through poisoning followed by systematic trapping, coyotes have been so thoroughly eliminated that sheep owners, with practically no losses, now permit their sheep to graze freely without close herding. Important lambing grounds

have been similarly protected so that ewes and lambs are allowed to range freely without being driven to bedding grounds at night. This has made it possible to carry at least one-third more ewes on a lambing ground, to save a higher percentage of lambs dropped, and at the same time to reduce the expense of handling. The practical elimination of coyotes from the range country will result also in a great increase in both the wool and the meat output. In addition to the sheep they kill, coyotes destroy many goats, calves, pigs, and domestic fowls, and are among the most destructive enemies of large and small game, including both birds and mammals. The bobcat ranks next to the coyote in destructiveness to sheep and goats, while wolves, mountain lions, and some bears cause heavy losses of cattle and horses.

Not all predatory animals are equally destructive of live stock. Some individuals become strongly marked among their fellows because of their depredations. This is particularly the case with mountain lions, wolves, and coyotes. As illustrative of losses caused by these animals, the following instances, which have occurred during the year, may be cited:

One mountain lion killed by a bureau hunter near Roosevelt, Ariz., had a record of destroying 50 calves and 3 colts on one ranch besides many killings on other ranches.

A trapper in New Mexico found 23 calves killed by a notorious wolf which he succeeded in taking; another wolf had killed 30 head of cattle in Wyoming before being captured; a pair of wolves killed near Split Rock, Wyo., were each reported to have killed from $1,500 to $2,000 worth of stock a year; another pair of wolves which were taken were known to have killed 100 sheep and 7 colts for one rancher and 50 sheep for another during the month before they were captured.

Coyotes in New Mexico were reported taking from 3 to 6 lambs each night from one ranch, notwithstanding the fact that Mexican herders were sleeping in close proximity and that the usual devices were employed to keep the animals away. After a bureau hunter had killed 7 large, old coyotes and 2 wildcats in the vicinity the losses entirely ceased.

In Custer County, S. Dak., during a period of six or seven years, one wolf still at large is credited with having killed more than $25,000 worth of cattle. Other notorious individual stock-killing animals occur in all parts of the range country.

Whenever a report of the activities of such predatory animals is made to a district inspector of the bureau, expert hunters are detailed to effect their capture. In this way the careers of many of the most notorious stock killers of the western ranges have been ended.

RABIES.

Predatory animals are carriers of rabies, which still persists in California, Nevada, Utah, Idaho, Oregon, and Washington. The destruction of these animals through the campaign led by this bureau has greatly reduced the occurrence of the disease and the losses caused by it. Now, whenever an outbreak of rabies is reported, trappers are concentrated about the locality, the affected animals are soon destroyed, and the disease promptly disappears. But for the

continuance of this preventive work rabies would quickly become as disastrous an epizootic as when its control was first undertaken.

CONTROL OF RODENT PESTS.

The work of rodent eradication has made a steady, consistent growth both in territory covered and in thoroughness of organization. In this the bureau has continued to cooperate through the States Relations Service with the State extension organizations, including county agents and farm bureaus. Wherever other State or local organizations were available, as State departments of agriculture and agricultural commissions, they also have been enlisted in the movement. The Forest Service has cooperated heartily in units of operation involving national forests, while the Office of Indian Affairs of the Department of the Interior has joined similarly in work on Indian reservations.

This cooperation, which has united all Federal, State, and local agencies in a carefully planned, concerted drive against rodent pests, has greatly increased the extent and effectiveness of the work. Under the leadership of bureau specialists detailed to organize and conduct these campaigns, rodent eradication has become one of the major projects of farm bureaus and of county agents in the territory now districted. The definiteness and value of the results accomplished and the promptness with which these returns on the effort and investment are secured have made this work one of outstanding importance in the movement to increase crop, forage, and live-stock production. Detailed plans for the organization and conduct of these cooperative campaigns are prepared in consultation between the district representatives of the Biological Survey, the State extension director, and the county agents. The bureau assumes the cost of operations on Federal lands, the State officials on State lands, and the farmers and stockmen pay the cost of work on private lands either directly or through taxes levied by the counties. Concerted campaigns systematically organized to destroy rodent pests over large areas of Federal, State, and private lands are proving an entirely practical way of coping with rodent pests, and have made it possible for the first time in the history of the country to make effective headway against them on a large scale.

In addition to the advantage derived by individual landowners from these concerted attacks under the guidance of bureau experts, farmers and stockmen have been saved many thousands of dollars a year by a plan of cooperative purchase of strychnine and other materials used in the poison operations. This was devised and put into effect by the bureau, and by it the enormous quantity of over 4 tons of strychnine has been arranged for and supplied at a very material saving in cost. In Idaho officials report that not only has this saving in that State alone amounted to $21,000 during the year, but also they have been enabled to secure the large quantities required promptly at the time needed for the most effective prosecution of the campaign. This latter feature has been most important in the development, without serious interruption or delay, of the extensive rodent eradication campaigns during the last three years.

The areas seriously infested by rodent pests in the States west of the Mississippi River comprise more than 200,000,000 acres. Field

operations during the last four years have shown that the worst of these pests, as prairie dogs, certain species of ground squirrels, and pocket gophers, can be eradicated from a great part of the farming and best forage-producing regions of the West at a cost which is merely nominal as compared with the annual increase in the production of the land. The large and constantly growing expenditure of funds and application of labor by cooperating farming and stock-raising communities are conclusive evidence of the practical character of these campaigns. Under the modern methods of the bureau, the first time the rodents are poisoned over a large area from 85 to 98 per cent of the animals are killed. This accomplished, follow-up measures to complete the work are organized as needed during the same and subsequent seasons.

PRAIRIE DOGS AND GROUND SQUIRRELS.

Prairie dogs and ground squirrels are the most widespread and conspicuously destructive rodents affecting cultivated crops and range grasses in the States west of the Mississippi River. They do their damage by digging out the planted seeds and cutting down the growing grain until harvested, by eating off alfalfa, clover, bean, pea, and similar legume and hay crops, and by feeding on forage grasses and digging out their roots, thus destroying the stand. Lands thus denuded of native grasses are often subject to serious erosion, resulting in permanent damage to the soil. Prairie dogs occur from Texas north to North Dakota and Montana and from Kansas west to Utah and Arizona. Ground squirrels of several species live in vast numbers over all of the States west of the Mississippi River, involving all of the area occupied by prairie dogs, but becoming most conspicuously destructive in the Northern and Western States, including the Dakotas, Montana, Wyoming, Idaho, northern Utah and Nevada, Washington, Oregon, and California.

The plans of organization, the seasonal work, and the methods of extermination for eradication campaigns against both these groups of rodent pests are essentially the same. The details differ somewhat, however, both with respect to the species concerned, the seasonal, weather, and crop conditions, and the topography of the country. The local representatives of the Biological Survey carefully observe and study these features and apply the measures which have proved most effective and economical.

Particularly notable results are now being secured on a large scale in the campaigns against prairie dogs in New Mexico and Arizona. An illustration of this work is furnished in one especially valuable range area in Sulphur Springs Valley, Cochise County, Ariz., a tract 12 miles long and 4 miles broad, involving 30,700 acres, which was completely cleared of prairie dogs last spring. Adjoining range occupants then appealed to the inspector in charge to assist them in conducting the work over their areas, with the result that by June 30 three-fourths of the area in both Cochise and Graham Counties was completely cleared of prairie dogs. Work to clear the remaining portions of these counties is progressing rapidly. The progress made in eradicating a very heavy infestation of prairie dogs from the valuable range areas of Moreno Valley, northern New Mexico, is another good example of the advance which is being made in the or-

ganized campaigns against these pests. In Kansas, after years of effort, extermination of prairie dogs was accomplished except for a few scattering small towns; through neglect of landowners to complete the work, reinvasion of adjoining cleared areas is beginning to occur. Effort is now being concentrated upon these small areas of infestation, involving 25 to 40 acre tracts, which are widely scattered throughout the middle and western counties.

Similar illustrations may be cited of effective work in the enormous campaigns now being waged against ground squirrels. In Camas Prairie, a fertile valley inclosed by mountains in Camas County, Idaho, where a heavy infestation of Columbia ground squirrels was on the point of driving out the settlers, relief was afforded through the organization of a campaign against the pests, with the result that at present scarcely a ground squirrel can be found in this area, involving 59,000 acres. In North Dakota the Richardson ground squirrel, commonly known as "gopher," formerly caused an annual crop loss estimated by State officials at $6,000,000 to $9,000,000, depending upon seasonal conditions. The eradication compaigns have now progressed to a point where in many counties these ground squirrels are no longer looked upon as a menace by the landowners, but merely as occasional objects of interest and curiosity. There is a strong tendency under these circumstances for landowners to discontinue the concerted campaign to complete their eradication. Every effort, however, is being made to have this work continued in such counties in order to prevent any possibility of the animals increasing to a point where they may again become destructive of crops. Indolence and neglect can be the only possible reason for such a condition arising, as under the leadership of the bureau and county agents the farmers have become thoroughly familiar with and experienced in effective measures for destroying these animals.

In the campaigns against prairie dogs and ground squirrels during the year, 19,117,737 acres of Federal, State, and private lands were given a first poison treatment, and follow-up work was done on 15,172,709 acres. Through State and county appropriations and funds expended by individual landowners, cooperative funds were contributed amounting to $841,909. The quantity of poisoned grain distributed amounted to 1,610 tons, while the number of farmers and stockmen actively cooperating numbered 121,435. The work resulted in a saving of crops for the year estimated at $10,000,000.

POCKET GOPHERS.

Extensive work has been done during the year in demonstrating methods of destroying pocket gophers and organizing community campaigns against them in Kansas, Nebraska, Idaho, Oregon, New Mexico, and Arizona. Many farmers report killing as high as 95 per cent of the pests with one application of poison. The animals occur in every State west of the Mississippi River, and are especially injurious to alfalfa and grazing lands, hay meadows, orchards, and root crops. They often ruin the stand of alfalfa by cutting off the tap roots, and in Kansas, State officials estimate the annual loss to the alfalfa growers alone from this source at $5,000,000. Pocket gophers greatly reduce the quantity of hay that can be harvested,

both by injuring the stand and by piling up mounds of dirt over considerable portions of the crop; these mounds interfere with cutting the hay and frequently damage the harvesting machinery.

In Kansas and Nebraska, where the pocket gopher is the most serious rodent pest affecting the producers, the efforts of the bureau representatives are concentrated particularly upon the organization of effective community campaigns for its eradication from farming districts. Excellent progress has been made and a foundation laid for more extensive operations during the coming year. In Arizona pocket gophers caused very serious losses in orange and grapefruit orchards by gnawing the roots of trees and thus killing them.

The burrows of pocket gophers in the banks of irrigation ditches have resulted in great damage in parts of Arizona, Idaho, and other irrigation States by causing breaks, which were followed by serious loss of water at critical periods, by the inundation and destruction of crops, and by large expenditures for repair of the ditch banks. Extensive poisoning operations were organized with a view to destroying the pests in such situations and preventing damage of this character. In Arizona chambers of commerce, associations of orange and grapefruit growers, water users' associations, and others joined actively with bureau representatives in conducting these campaigns. The Office of Indian Affairs cooperated by poisoning these animals on considerable areas of the Moqui and Parker Indian Reservations in Arizona. The Forest Service also has given active cooperation in Nebraska, Oregon, and other States.

The same general lines of procedure are followed in initiating and organizing campaigns for the destruction of pocket gophers as in the case of other rodents, and, with a like cordial response by the people interested, important results were attained in protecting crops and property from damage by these animals.

JACK RABBITS AND COTTONTAILS.

Jack rabbits are seriously destructive in many of the Western States. They frequently concentrate in enormous numbers in grain fields, orchards, vineyards, and other cultivated areas by moving in from surrounding sagebrush or range. In such instances they completely devastate large fields of growing grain, eat off the crowns of the young alfalfa, and entirely destroy valuable orchards and vineyards that have been built up only after large expenditures and years of unremitting toil. Pathetic instances have occurred where orchards representing the work and savings of a lifetime and constituting the sole reliance of the owners for future support, have been brought to a bearing age only to be destroyed in a single night by jack rabbits. During the winter these animals also congregate about stacks of hay and grain provided for winter stock feed, and frequently eat around and undermine them to such an extent that the stacks topple over and become practically a complete loss. The rabbits also make heavy inroads on the crop of long staple cotton, an important and rapidly developing feature of production under irrigation in Arizona. Last year one producer near Chandler, Ariz., lost from this source his entire cotton crop valued at $2,500. This year a campaign was organized in this vicinity to destroy the rabbits, and in it many thousands

of them were killed; as a result, no damage has since resulted to the cotton crops in this locality.

Campaigns for the destruction of jack rabbits were organized on a large scale in Idaho, Oregon, Washington, Nevada, Utah, and Arizona under the leadership of bureau representatives and along cooperative lines similar to those employed in combating other rodents. In some instances the destruction of these animals was accomplished through extended poisoning operations. In Lincoln County, Idaho, farmers reported an average of 400 rabbits killed with each ounce of strychnine used, while two farmers in Gooding County reported killing 1,000 rabbits with each ounce. Minidoka County reported killing 40,000 rabbits in their poisoning campaign. Great numbers of jack rabbits were also destroyed by organized drives in these States. In some instances the animals were shot as the drive progressed toward a point of concentration made by converging fences or natural barriers. In others they were driven into fenced inclosures and killed. The destruction of as many as 10,000 jack rabbits resulted from individual drives of this character. Farmers report practically complete protection of their crops the present season in localities where these campaigns were conducted.

Many thousands of skins of the rabbits thus killed were cured and marketed at good prices. Wherever it was practicable to do so the carcasses of unpoisoned rabbits were also prepared and shipped to city markets for human consumption; in other cases they were utilized as feed for chickens and hogs. In some localities it was possible to keep jack rabbits under control merely by bringing the market value of the skins and carcasses to the attention of the people.

Complaints of damage by cottontail rabbits were received from many localities throughout the country. As an example of the destructiveness of cottontails may be cited a new 3-acre vineyard planted during April, 1920, in a foothill location in Tulare County, Calif. Before the end of May the vines had been completely destroyed, the rabbits even digging down to get at the tender sprouts. This delay of a year in establishing the vineyard, together with the money expended on it, involves the loss of hundreds of dollars and is an illustration of the kind of damage done in numberless places on a great variety of garden truck and orchard crops. Advice covering methods of control by means of properly built woven-wire fences and the employment of poisons and traps has been given numerous inquirers desiring to eliminate losses from this source.

MICE, WOOD RATS, AND COTTON RATS.

Damage by various kinds of meadow and pine mice in orchards has been very widespread, extending from the orcharding sections of Virginia, Maryland, Pennsylvania, and New York west to Washington, Oregon, and Idaho. In the last three States assistance was rendered the orchardists through the bureau's regular force of experts engaged in local rodent-eradication work, and effective measures of destroying these pests were demonstrated. In the Eastern States orchardists, florists, and truck farmers were aided through circulars and bulletins describing methods of eradication. In a few instances it was possible to detail representatives from the Washington office to near-by points to demonstrate effective procedure.

Wood rats have continued to do damage in some localities, especially in forest and nursery plantations throughout the West. As cases of this kind were reported they were dealt with by representatives of the bureau in the territory affected by means of written instructions or demonstrations.

Cotton rats and rice rats have been responsible for considerable damage in Florida to the sugar-cane crop. Effective methods of poisoning these animals were determined and the planters advised regarding practical procedure.

BEAVERS AND WOODCHUCKS.

In some localities, especially in the State of Washington, beavers caused considerable damage to orchards and farm crops as well as to timber in areas along streams where they construct their dams and houses. Investigation disclosed that in many cases the damage was sufficiently serious to warrant removal of the animals. Arrangements were made with State game officials for the necessary captures and for the removal of the beavers to other places where they could be permitted to multiply without endangering valuable timber supplies or cultivated crops.

Mountain beavers, or sewellels, also have continued to do considerable damage in Washington and Oregon to crops and vines planted on areas adjacent to timber lands occupied by these animals, and bureau representatives have demonstrated methods for their control.

Woodchucks have been a source of annoyance and loss to gardeners, truck growers, and farmers throughout New England and the Northern States west to Oregon and Washington. Following the introduction of alfalfa, clover, and succulent root crops in the Northwestern States, woodchucks have concentrated about these new sources of food supply, frequently traveling considerable distances to feed upon them. Their depredations have caused heavy losses, wide strips along the borders of fields often being completely destroyed. As the animals live under a great variety of conditions throughout the infested area, it has been necessary to develop methods adapted to meet the different conditions prevailing. Demonstrations are given or circulars outlining procedure issued as required by individuals or communities.

HOUSE RATS AND MICE.

The educational campaign to acquaint the public with the seriousness of the drain on the Nation's food resources through depredations of house rats and mice has been continued. This has involved considerable investigational work with a view to improving methods of poisoning and trapping the animals, devising effective means of excluding them from buildings and places where they could damage food or other stored property, and employing deterrents where other means of exclusion are impracticable.

In response to inquiries from points throughout the United States, bulletins, circulars, and other information regarding practical measures for destroying rats and excluding them through rat-proof construction and the use of deterrents have been supplied. Requests have

been received from military and naval officers in charge of camps, arsenals, and storage warehouses for the inspection of these places by experienced representatives of the bureau and for specific directions regarding procedure in destroying the rats or protecting property from their depredations. This was done at the naval base, Norfolk, Va.; at the arsenal and military camp located at Amatol, N. J.; and at the Picatinny Arsenal, Dover, N. J., where effective control measures were inaugurated and carried out. In other instances the situation was met by sending bulletins and furnishing other necessary information. State officials and public health officers of cities also appealed to the bureau for practical plans of organizing extended eradication campaigns and for suggestions regarding legislation or ordinances which should be put into effect with a view to complete and permanent rat control.

Interest on the part of State and municipal public health officials was stimulated by the appearance of bubonic plague at Beaumont and Galveston, Tex., and at Pensacola, Fla., with the possibility confronting them of its further spread. The rat serves as a carrier of fleas responsible for the transmission of the plague to human beings, and because of its extended movements from place to place within a city and from point to point throughout the country it becomes an active agent in disseminating this malignant disease. This situation, together with the fact that the rat is a notorious carrier of filth-borne diseases and a destroyer of property by contamination, also of food, feed, clothing, farm machinery, and harness and other leather goods, has emphasized the importance of carefully planned, thoroughly organized, and vigorously conducted campaigns for the destruction of all rats. Attention has been called to the fact that State laws and city ordinances should require all new buildings to be made rat-proof, and should also require the adoption of practicable measures for rat-proofing existing buildings, sewers, and water mains. Such action is of the utmost importance in any plan to eliminate the enormous losses of property and to remove the constant menace from disease due to the widespread abundance of house rats and mice.

Representatives of the bureau were detailed to visit Norfolk and Portsmouth, Va., and Baltimore, Md., to advise and assist the local officials in working out comprehensive plans for the organization of campaigns to destroy rats. Considerable assistance has also been rendered in urban and farming communities by local representatives of the bureau in connection with their regular field operations against rodent pests in the organized districts of the West. Emphasis has constantly been placed upon the absolute necessity for the rat-proof construction of buildings and storage places in both urban and rural communities as a means of obtaining permanent relief from rats, and upon the necessity for preventing the pests from finding harborage and having ready access to food supplies, as an essential preliminary step to the carrying out of effective measures for destroying them.

MOLES.

Many reports have been received from the Eastern and Middle States of damage by moles to lawns, garden and truck crops, and flower nurseries. While not rodents, moles are frequently confused

with them because of certain superficial resemblances in size, general outline, color, and pelage. Damage caused by moles has been, as in other years, closely associated with the work of mice, which frequently follow the mole runways. This damage by moles is often very serious, particularly in light sandy situations, where their lifting up of the surface soil injures the roots of plants and permits them to dry out, resulting in their death. The Townsend mole, the distribution of which is limited to the coast counties of Washington, Oregon, and northern California, has been destructive in vineyards, gardens, hay meadows, and lawns through its habit of burrowing near the surface of the ground and piling up mounds of dirt on the surface. Trapping moles with specially designed traps has proved to be the most practical way of combating them. Information regarding suitable traps and trapping procedure has been disseminated through bulletins and the press.

The value of moleskins was established among fur dealers through efforts of the Biological Survey, and methods of trapping the animals and preparing their pelts for market have been widely demonstrated throughout the infested territory. These demonstrations were conducted in cooperation with the public schools, the State extension services, and other agricultural agencies. Many successful boys' and girls' clubs were organized to trap moles and prepare their pelts for market, for the combined purpose of ridding the land of a pest and obtaining profits from the sale of the skins. As a result large numbers of these animals have been taken and their pelts marketed at good prices. Reports received from leading fur dealers indicate that the number of American moleskins marketed during the year showed an increase of approximately 20 per cent over the preceding year, representing a value of about $60,000 for the raw furs.

PRODUCTION OF DOMESTIC RABBITS.

By the development in this country of a well-sustained interest in the production of domesticated rabbits there has been a rapid increase in the number of people who are raising them and in the number of animals produced. Many of the animals are used for home consumption, as the meat compares favorably with that of the domestic fowl and possesses high nutritive value. Rabbit meat has also come to be a popular item on the menu of hotels and restaurants wherever its good qualities have been demonstrated and an adequate supply can be furnished.

The cost of rearing rabbits is so low that they have been found a profitable adjunct to other lines of farm production. Many extensive plants have been established to raise them for the larger city markets, and great numbers also are being produced in the back yards of city residences. The pelts of these animals also have considerable value for felting and other manufacturing purposes. There has been a marked increase in the quantity of rabbit skins marketed and in the use of these skins by manufacturers of hats and of trimmings for coats and other wearing apparel. They are used in their natural color and are also clipped and dyed in imitation of more expensive grades of fur.

National and State rabbit breeders' associations are now well organized and are working actively for the development of the rabbit

industry as an important feature of the meat-production program of the country. Rabbit raising has also proved a popular phase of the activities of boys' and girls' clubs in many sections of the country. The Biological Survey has endeavored to stimulate this rapidly growing phase of animal production and guide it along practical lines. Farmers' Bulletin 1090, covering breeds of rabbits, plans for hutches, methods of feeding, breeding, marketing, and dressing rabbits and cooking the meat for food, with a section devoted to the treatment of the diseases of rabbits, was issued during the year. In order that inquirers might know where to obtain breeding stock and where to dispose of their output, lists of the principal rabbit breeders in the different States, and buyers of rabbits and rabbit skins have been maintained by the bureau.

Representatives of the bureau have kept in close touch with leading rabbit producers throughout the country and have inspected a number of the more important rabbitries and visited establishments devoted to the dressing and dyeing of rabbit skins. At the request of officials in charge, a representative of the bureau was also in attendance at the annual convention of the American Breeders and Fanciers' Association, held at Cleveland, Ohio, and at the rabbit show held at Baltimore, Md.

FUR-BEARING ANIMALS, THEIR PROTECTION AND PROPAGATION.

Many interesting features regarding the status of the fur industry have been developed as a result of investigations conducted during the year. Representatives of the bureau have visited the principal raw fur markets, including those in St. Louis and New York and in Montreal, Canada; and also have visited establishments engaged in the dressing and dyeing of furs and in the manufacture of fur garments. Studies have been made of conditions prevailing throughout the country as to abundance of wild fur-bearing animals, and maintenance of adequate breeding stock of the more valuable forms, with a view to the development of sound State and National policies in regard to trapping that would maintain the number of fur bearers at the maximum consistent with other agricultural and commercial interests. On invitation of Canadian officials, a representative of the bureau was detailed to attend a conference of the Commission of Conservation and the Advisory Board on Wild-Life Protection, at Montreal, February 19–20, for the purpose of discussing matters relating to the rearing, registration, and importation of silver and black foxes and other fur bearers in Canada and the United States, and of considering plans for the conservation, increase, and proper utilization of fur-bearing animals.

The value of pelts taken from fur bearers throughout the United States runs to a total of many millions of dollars annually without taking into consideration the large amount of labor and capital employed in their manufacture or the value of the product as it goes to the wearer.

North America has long been one of the most important regions of the world for taking the pelts of wild fur-bearing animals. More recently it has become one of the greatest world centers for the marketing and manufacture of furs. As illustrative of the extent of the fur business, it is estimated that there are approximately 18,000

people in New York City engaged in the various branches of the fur industry and that the capital invested there amounts to about $200,000,000. During a period of 12 days in February, 1920, one firm in St. Louis sold peltries valued at $27,000,000. A few days later a New York firm sold furs having only slightly less value, while in May the St. Louis firm listed furs for sale valued at $30,000,000.

A survey of conditions throughout the country indicates that the supply of wild fur-bearing animals has decreased very materially during the last decade. This is doubtless due to the large number of people who, during a portion of the year at least, engage in trapping fur bearers, as a means of increasing their incomes. The exceedingly high prices which have prevailed for furs during the last few years have stimulated trapping activities to a remarkable degree, resulting in a serious depletion of the supply of wild fur-bearing animals in many sections of the country. The fur industry from trapper to manufacturer has developed to a point where it is worthy of the most careful consideration and the employment of all practicable measures to maintain the supply on a basis which will meet the requirements of the future and lay the foundation for the permanency and growth of the industry. Trappers, raw fur dealers, manufacturers, and Federal and State officials concerned with wild-life conservation work should unite in working out and establishing policies directed toward this end. This affects in a very material way present and future financial interests, besides providing fur garments to meet the demands of the constantly increasing number of persons who use them for physical comfort and for the satisfaction and enjoyment coming from wearing the more luxurious articles of apparel. While prices declined considerably at spring sales, it appears probable that owing to the world-wide decrease in the natural supply, prices will continue in future at a high level.

With a view to fostering and guiding the production of fur-bearing animals under conditions of domestication, the bureau has initiated and conducted experimental and practical studies of silver, black, blue, cross, and red foxes, fishers, martens, minks, skunks, and raccoons, and of animals which may be reared under semicontrolled conditions, including beavers and muskrats. These investigations have been conducted in part at the Experimental Fur Farm, near Keeseville, N. Y., on the ranches of successful fur breeders, and on marshes and streams under patrolled and natural conditions.

Carefully outlined studies are in progress of diseases that affect fur-bearing animals, both those of bacterial and those of parasitic origin. The specific causes and also the course and symptoms of such diseases are being investigated, and studies are being made of means of prevention and methods of treatment, practical ways of disinfecting pens, dens, and houses, and means by which they may be maintained in a sanitary and healthful state. Studies were continued of feeds and feeding practices with a view to economy of production and maintenance of health and vigor in the animals, and of soil, climatic, housing, and other conditions favorable to the production of furs having the highest marketable qualities. Studies are also in progress of fur quality and grade and the characteristics upon which these are based, including means of identifying accurately the kinds of fur that are now placed on the market under a great variety of trade names. The latter feature is of much importance

because of the skill with which inferior furs are now dressed and dyed in imitation of more valuable peltries.

During the year much information has been furnished inquirers through correspondence and the issuing of circulars and bulletins. An article entitled "Trapping on the Farm" was published in the Yearbook of the Department of Agriculture for 1919, and a manuscript for a department circular completed for publication on "Maintenance of the Fur Supply."

ECONOMIC ORNITHOLOGY.

As in the previous fiscal year, investigation of damage by various birds protected under treaty between Great Britain and the United States was a special feature of the work. Provisions of the migratory-bird treaty act authorize the Secretary of Agriculture to issue permits to kill any of the protected birds when found seriously injurious to agricultural or other interests. This is a wise and beneficent arrangement, for there is no doubt that the true interests of both bird protection and agriculture are furthered by facilities for the constant adjustment of the numbers of birds in relation to the supplies of food they may consume without detriment to man. When birds increase to such an extent that these supplies no longer suffice for them, and they make serious inroads on cultivated crops, control measures are justified, and it is fortunate that the department has at its command this indispensable part of a well-balanced program in economic ornithology.

Investigations of the economic relations of various groups of birds were continued during the year, the birds receiving most attention being the English sparrow, the vireos, yellow-legs, Wilson snipe or jacksnipe, hawks, and owls, and the redhead and scaup or bluebill ducks. A number of manuscripts were prepared for publication, those not mentioned elsewhere in this report being "The Crow in Its Relation to Agriculture" and "Community Bird Refuges," prepared for publication as farmers' bulletins; and as department bulletins, a report on the "Fish-eating Birds of the United States," "Food and Economic Relations of North American Grebes," "Food of American Phalaropes, Avocets, and Stilts," and "Food Habits of the Vireos."

MEADOWLARKS AND DOVES IN SOUTHERN STATES.

An investigation conducted during the year having demonstrated that meadowlarks are seriously destructive of sprouting oats and corn in South Carolina, an order was issued by the Secretary of Agriculture permitting aggressive measures against the birds from November 1, 1919, to April 30, 1920. Investigations of similar complaints against mourning doves were not conclusive.

ROBINS DESTROYING CHERRIES IN NEW YORK.

Complaints that robins do considerable damage in the commercial cherry-growing regions of New York, received both from individual fruit growers and from horticultural organizations, led to an investigation of the trouble. It was found that during the ripening season of small fruits robins were securing most of their sustenance from

them and the damage done amounted to about 10 per cent of the crop in the case of sour cherries and to 75 and even 100 per cent of sweet cherries. An order was therefore issued permitting the killing of robins from June 1 to July 15, guarded by numerous restrictions designed to prevent abuse of the permit, especially the killing of birds other than robins.

FISH-EATING BIRDS.

Partly from a general study of the economic relations of fish-eating birds and partly from a special investigation of the subject in Minnesota, Wisconsin, and Michigan, it became evident that certain fish-eating birds are a pronounced nuisance about fish hatcheries. The peculiar conditions at hatcheries that make the visits of fish-eating birds so destructive are that all fishes on the premises are of valuable kinds, and as they are confined in great numbers in shallow pools they fall easy prey to such birds. For these reasons birds which may be nearly harmless under natural conditions, preying chiefly on worthless fishes, the valuable kinds being in the minority in their habitat, become at fish hatcheries exclusively and often highly injurious. The birds which most often resort to fish hatcheries and which are named in an order of the Secretary of Agriculture permitting aggressive action against them at such places are the grebes, loons, gulls, terns, mergansers, the bittern, great blue, little blue, and green herons, and the black-crowned night heron.

One of these groups of birds, the mergansers, or fish ducks, have been accused of doing much damage in trout streams, particularly in Michigan. From three different investigations of the matter it has been learned that while mergansers occur in small numbers on most Michigan streams, they are very fond of trout and occasionally in severe winters concentrate on certain trout streams in such numbers that great destruction of these valuable fish must ensue. A permit, therefore, has been issued authorizing employees of the game, fish, and forest-fire department of the State of Michigan to control the number of mergansers.

DAMAGE BY OTHER MIGRATORY WILD FOWL.

In Back Bay, Va., and Currituck Sound, N. C., swans have increased considerably in numbers and much more in fearlessness as a result of the long term of protection they have enjoyed. They have changed their habits by coming to feed in small ponds in the marshes, a thing they rarely, if ever, did during the period in which they were hunted. The small ponds they visit are the chief attraction for the wild ducks on the premises of the various ducking clubs of the region, but the feeding operations of the swans, which may not be shot, soon deplete the stock of duck food in the ponds and render them unattractive to the ducks, the game chiefly sought by the clubs. Damage to shooting properties undoubtedly occurs, but owing to local complications which would result in remedial measures being misunderstood, and, further, to the very important fact that the region where damage occurs is the winter home of practically all the swans of eastern North America, and that preservation of the birds absolutely depends upon the treatment they receive there, it has thus far been deemed inexpedient to authorize control measures.

A report to the effect that wild geese are doing serious damage to fields of young grain, similar to other reports reaching the bureau periodically, came during the year from eastern Maryland. Upon investigation it proved baseless. The fact is that in most cases the cropping of young grain by geese really improves the stand by stimulating increased "stooling." Indeed, to secure this very effect, farm practice in some regions includes regular grazing of young grain by domestic stock.

CROWS DESTROYING ALMONDS IN WASHINGTON.

In the Goodnoe Hills region along the Columbia River in Washington crows are unbelievably numerous and have become very destructive to melon, apricot, and almond crops. An investigation made during the almond season showed that in two or three days the crows would consume the crop of one orchard and then move on to the next. Orchards were entirely stripped of nuts and the ground beneath strewn with almond husks and shells. Control experiments were at once begun and gratifying success was achieved. Poisoning operations, in which green almonds were used for bait with strychnine as the poison, killed many of the crows and struck terror into the flocks of these wary birds so that they deserted the orchards. Poisoning an orchard every 10 days has been found to give it immunity from crow damage.

INVASION OF THICK-BILLED PARROTS.

The thick-billed parrot is a Mexican species which at irregular intervals migrates from northern Mexico and appears in the United States in the Chiricahua and other mountain ranges near the border. It has been stated that last year these birds attacked feterita and other grains growing in the arable land in these mountains, which in recent years have been placed under cultivation. It was learned that the parrots entered the Chiricahua Mountains in large flocks during July, 1917, and remained in numbers until fall. On their arrival they began to feed upon cones of the Chihuahua pine, and when these were gone they turned their attention to acorns, of which there was an abundant crop. Though they often came into trees bordering clearings that contained cultivated fields or orchards, it was found that they had not damaged crops in any way in spite of many reports to the contrary. Nor did it appear that the pines or other trees on seeds of which they fed were harmed. From the data gathered it was established that at present the thick-billed parrot is to be considered a harmless species.

RELATION OF POISONING CAMPAIGNS TO BIRDS.

From time to time reports are received of numbers of birds being killed by poisoning operations directed against other animals. Such charges have been associated with the spraying campaign for the control of the gypsy moth in New England, with laying poisoned mashes for cutworms in various parts of the country, and with the poisoning operations of the Biological Survey against noxious rodents and

predatory animals in the Western States. Fortunately all fears as to significant destruction of birds in these campaigns have proved unfounded. In the last annual report of the bureau mention was made of an investigation connected with this problem which showed that quail certainly are not endangered by poisoning operations against ground squirrels in California. During the year two investigations were made to ascertain the relation of poisoning campaigns to birds. The first related to the use of arsenic and bran preparations in poisoning grasshoppers in North and South Dakota. Reports of birds being poisoned were investigated in the vicinity of Pierre, S. Dak., and of Dawson and Jamestown, N. Dak., and it was found that very few birds had succumbed, not enough to cause alarm. The second investigation resulted from reports of the destruction of large numbers of beneficial migratory birds in connection with an antivermin campaign in Pennsylvania. While no specific evidence was found to substantiate the reports, it was learned that unscrupulous persons in efforts to secure fur-bearing animals had distributed poison in a way that might cause the destruction of some wild-bird life. This practice was particularly dangerous to dogs and, if continued, even threatened the extermination of certain valuable fur bearers. Not all the animals that would suffer from this promiscuous poisoning could be considered vermin. The methods of crow control recommended by the State game and fish commission were not found to be dangerous to other wild birds.

FEEDING PLACES OF WILD DUCKS.

The bureau's work to aid in the improvement of feeding grounds of migratory wild fowl was continued during the year. Surveys were made of 26 lakes and ponds in Missouri, 5 in Michigan, and 1 in Tennessee, and reports including recommendations for improving conditions were made to individuals and associations interested. An extensive report on the marsh and aquatic vegetation of North Dakota, based on surveys of approximately 500 lakes, was completed during the year.

BIRDS AS ENEMIES OF INSECT PESTS.

Three special investigations of the relations of birds to outbreaks of insect pests have been undertaken during the year. For the last three years there have been serious infestations of grasshoppers in various parts of the Dakotas, the outbreak of the summer of 1919 being the most severe. In many places practically all vegetation was consumed and in others crops were so badly damaged that no attempt was made to harvest them. Information was obtained from the infested areas on the food habits of 27 species of birds, 25 of which were feeding on grasshoppers. From a third to all of the food of these birds was found to consist of grasshoppers, 19 of the species attaining the 100 per cent mark. The birds having the best record as grasshopper consumers were the lark sparrow, meadowlark, Franklin gull, Arkansas kingbird, crow blackbird, and common kingbird.

The Japanese beetle, an imported insect, has become thoroughly established in New Jersey, is very abundant, and does much damage.

Information regarding its bird enemies being desirable, a preliminary investigation was made. The kingbird, starling, meadowlark, crow blackbird, cardinal, and catbird were found to feed upon the pest. The investigation will be renewed the coming year.

As the fiscal year closed, an investigation was under way in Massachusetts to determine the relation of birds to the European corn borer, an insect that is arousing great apprehension among eastern agriculturists.

COOPERATIVE STUDIES OF BIRD FOOD.

Examinations of special collections of stomachs of birds for the benefit of individuals and organizations requiring definite information on the food habits of birds at certain localities and seasons, long a minor feature of the work in economic ornithology, were unusually numerous during the year. The material examined was donated to the bureau, thus passing into its general collection. Among the collections examined in this way were a series of wild-duck stomachs from Massachusetts, Michigan, and Alaska; one of hawks from New York; owls from New Jersey; owls and woodpeckers from Oregon; quail from New York and Georgia; crossbills from Indiana; rosy finches and Canada jays from Yellowstone Park; rosy finches and ruffed grouse from British Columbia; and miscellaneous birds from New Mexico and Peru.

BIOLOGICAL INVESTIGATIONS.

With the resumption of peace conditions and the return to the service of several members of the scientific staff from overseas duty the work of the Division of Biological Investigations has returned to normal and during the year developed certain new activities.

Field and laboratory work has been conducted along lines helpful to other activities of the bureau, including the enforcement of the migratory-bird treaty act and of the Lacey Act, which regulates the importation of birds and wild mammals and interstate commerce in game, administration of mammal and bird reservations, general conservation of game mammals and birds, and the lines of work bearing upon the economic relations of mammals and birds to agriculture, forestry, and stock raising. Progress has been made in adding to and arranging the various card indexes recording information on the distribution, abundance, and habits of North American mammals and birds. These files contain a large volume of data collected from all possible sources, including the manuscript reports of field parties of the bureau, notes gleaned from correspondence, reports from other bureaus, scientific institutions, and innumerable private individuals, abstracts from publications, and the results of examination of specimens submitted by colleges, museums, and individual collectors throughout North America. These files have become increasingly valuable from year to year and have enabled the bureau to become a clearing house for information regarding the wild birds and mammals of this continent. Thousands of letters are annually written in response to inquiries received from all parts of the country on these subjects.

DISTRIBUTION AND MIGRATION OF BIRDS.

The work on bird migration has been carried on along lines followed during previous years. The effect of the war is still apparent in the lessened number of persons able to cooperate with the Survey in gathering data on bird migration, but an improvement is noticeable. As a result of special efforts it is expected that the number of volunteer observers will be greatly increased during the next year. Reports on bird migration were received from more than 250 observers, and many of them contained both spring and fall records. Progress has been made in abstracting records from published sources, and the work of copying the field notes of the various members of the Survey has been brought up to date. The number of record cards in the distribution and migration files, including bibliography, is now about 1,400,000. These files are in constant use in connection with the work of the bureau and in replying to correspondence.

No general publications have been issued during the year, but the following are nearly completed: "Distribution and Migration of North American Terns and Their Allies," "Distribution and Migration of North American Grebes, Loons, and Auks," and a circular of instructions for bird banding.

BIRD BANDING.

As an aid to the study of the migration of birds the work of the American Bird Banding Association was taken over and active preparations for carrying it on have already been made. It is planned to develop the investigations along two principal lines—the banding of waterfowl on their breeding and wintering grounds and the systematic trapping and banding of the smaller land birds. Results already obtained by the independent prosecution of the last-named line of work by a few private individuals have shown that this method of studying bird migration affords information of great importance; for instance, knowledge of the routes followed by individual birds in traveling between their wintering and breeding grounds. It is certain that the systematic and energetic prosecution of this method of research by a central agency which will enjoy the cooperation of many independent observers will result in the accumulation of a mass of valuable information on the movements of birds and will throw light on many obscure problems connected with this interesting study. During the few months that this work has been directed by the Survey it has attracted wide attention from both sportsmen and naturalists throughout the country. Cooperation has already been promised by most of the State game commissions and by many private individuals and organizations so situated as to be able to furnish substantial assistance.

BIRD COUNTS.

Reports of the sixth annual series of counts of birds breeding on selected areas, mainly on different types of farm lands in various parts of the United States, were received from about 30 observers, who reported on 45 separate areas. Many of these counts were made on areas reported on during previous years. This part of the work

of the bureau, like that of bird migration, has suffered from war conditions; but special efforts are being made to enlist the services of new observers and to interest old observers in resuming their cooperation, thus adding to the value of this important work. A third report on bird counts in the United States, detailing the results obtained since the last publication on the subject, is in course of preparation, and it is believed that its appearance will stimulate the interest of observers and result in a large increase in the number of reports received.

BIOLOGICAL SURVEYS OF STATES.

Field work has continued in Florida, Montana, North Dakota, Washington, and Wisconsin in furtherance of the biological surveys which have been in progress in those States during past years.

During January and February a party investigated conditions along the Gulf coast of Florida from Choctawhatchee Bay south to the Chassahowitzka River, particular attention being paid to the resorts of wintering ducks and other waterfowl.

In Montana, the valley of the Missouri and the bordering plains and mountains, from the mouth of the Milk River westward, were investigated during the early summer. In the latter part of the summer explorations covered the Little Rockies, Moccasin Mountains, Big Belt Mountains, Little Belt Mountains, and the Castle Mountains.

In North Dakota an investigation was made during September and October with special reference to the hibernation and food-storing habits of various small mammals. This resulted in the accumulation of considerable data regarding the food habits of several species of economic importance.

In Washington explorations were conducted from early in July to late in September, 1919, mainly in the region of Mount Rainier National Park, work on this particular area being undertaken with the cooperation of the National Park Service, the State College of Washington, and the Washington State Normal School. During this investigation as thorough a study as possible of the zonal and faunal conditions of the region was made. A detailed report on Mount Rainier National Park, including a topographic description of the region, results of studies of the life zones, and extensively annotated lists of the birds and mammals, is well advanced in preparation and is expected to be published by the National Park Service. During the remainder of the fiscal year an assistant of the Survey was continuously engaged in investigating faunal conditions in various parts of the State.

In Wisconsin investigations were conducted from July 1 to September 20, mainly in the northwestern part of the State, special attention being given to the Apostle Islands, in Lake Superior, the fauna of which was practically unknown. This resulted in the discovery of many interesting facts concerning the detailed distribution of the species on the various islands. As during previous years, the work in Wisconsin was conducted in cooperation with the Wisconsin Geological and Natural History Survey. After the completion of this work, early in September, a special investigation of the distribution and habits of beavers in the northern part of the State was

conducted in cooperation with the Wisconsin Conservation Commission.

"The Mammals of Panama," prepared by an assistant biologist of the bureau as one of the results of a cooperative biological survey of the Canal Zone conducted in 1911 and 1912, was published by the Smithsonian Institution during the year. Other manuscripts based on field work of the Biological Survey completed, but not yet published, include the "Mammals of Alabama," "Mammals of New Mexico," "Mammals of North Dakota," "Mammals of Wyoming," "Birds of Alabama," "Birds of New Mexico," and "Birds of Texas." Partial arrangements have been effected for the publication of the three last-mentioned reports by the States interested, and it is hoped that those of Alabama and New Mexico will soon be issued. Technical studies of several groups of North American mammals have also been conducted during the year, and the results of one of these, a revision of the pikas, or conies, was completed.

BREEDING GROUNDS OF MIGRATORY WILD FOWL.

In continuation of the investigations of the breeding grounds of ducks and other waterfowl on the Great Plains, which have been prosecuted annually for several years past, the lakes of North Dakota were visited during July. In this section a great increase in the number of ducks as compared with previous years was noted.

In the spring of 1920 arrangements were made with the cooperation of a private individual interested in the distribution of waterfowl to investigate the breeding grounds of ducks and other species of migratory game birds in the delta of the Athabaska River in central Canada. Owing to the unusually favorable conditions in this large area of marsh lands it is frequented during the breeding season by vast numbers of waterfowl which winter to the southward, principally in the United States. This section is probably the most important single area resorted to by breeding waterfowl in North America. A party led by an assistant of the bureau was engaged in an intensive study of conditions in this area throughout the spring and summer. In addition to conducting studies of the abundance, local distribution, and breeding habits of all the species nesting there, it is purposed to band as many as possible of the young birds as an aid to determining the lines of flight and the wintering grounds of the various species. The results obtained by this party will undoubtedly prove of great interest and value in the study of bird migration and in the intelligent administration of the migratory-bird treaty act.

During the year considerable publicity was given to the suggestion that migratory-bird treaties similar in character to that between the United States and Great Britain be negotiated with the countries lying south of our border, including South America. The Senate, on February 9, 1920, passed a resolution asking the President to consider the negotiation of such treaties. To this the President replied on March 13, transmitting letter from the Secretary of Agriculture, to the effect that lack of definite information concerning conditions affecting migratory birds in Mexico and other Latin American countries renders it unwise to take up the matter of treaties for bird protection until sufficient facts are available to indicate their justification. It is known that a serious destruction of migratory game

birds occurs every winter in Mexico, but conditions in that country have not been propitious for a migratory-bird treaty.

A considerable number of our important waders and shorebirds, especially golden and black-bellied plovers, winter in Argentina and adjacent countries, and their future conservation may depend on conditions attending the rapid development of agriculture in that remote region. In order to have the necessary first-hand information regarding this, an assistant biologist was detailed to proceed to Argentina and adjacent countries in time to witness the arrival there of our migratory wild fowl during their southern migration in the summer of 1920 and to continue his investigations relating to these birds in their winter home until they return northward again in the spring of 1921. He sailed for Buenos Aires on May 29 and should bring back much valuable information bearing on the future of many of our well-known species.

WILD LIFE IN NATIONAL PARKS AND NATIONAL FORESTS.

Late in September, 1919, a representative of the bureau visited the Black Hills of South Dakota to investigate the topography and food resources of an area which has been proposed as a game and bird refuge, to determine its fitness as a reservation for the protection of wild life.

An investigation was begun late in October in cooperation with the Forest Service to ascertain the conditions affecting the herd of elk at different seasons on the Sitgreaves National Forest, Ariz., variously estimated to contain from 300 to 500 animals. These are the progeny of a number of elk introduced from the Yellowstone Park region several years ago. The work was resumed in January, when the winter range and the approximate number of elk composing the herd were determined. Another trip was made to the region during the latter part of June to ascertain the summer range of the herd and to secure data on which to base final recommendations regarding the extent and approximate boundaries of a proposed game refuge. This investigation was still in progress at the close of the fiscal year.

During the first half of April an investigation of the condition of the elk wintering in the Jackson Hole region was made, special attention being given to certain areas in the Hoback Valley, along the slopes of the foothills bordering Jackson Valley on the east and in the valley of the Gros Ventre, all within the confines of the national forests, on which, by virtue of arrangements made in 1917 with the Forest Service, grazing by cattle was restricted in order to conserve sufficient forage for wintering elk. Further joint investigation by this bureau and the Forest Service is planned during the summer. The National Park Service will also have men in the field in order that the three bureaus interested in the Yellowstone elk herds may work effectively for their conservation. A new edition of the circular of information concerning Yellowstone National Park, which is issued annually by the National Park Service and which appeared in the spring of 1920, contains revised lists of the mammals and birds of this area, contributed in part by a field naturalist of this bureau. In addition, a comprehensive treatise on the mammals of Yellowstone National Park is in the hands of the National Park

Service for publication, and a large manuscript map showing the life zones of the Yellowstone National Park and the region adjoining it on the south was prepared for the use of the National Park Service. Lists of a few characteristic birds and mammals of Mount Rainier National Park have already been published by the National Park Service in its circular of information, and, as already stated, a detailed report on the region is well advanced in preparation.

RELATION OF RODENTS TO FOREST PRODUCTION.

Progress was made in experiments being conducted to secure information concerning damage to crops and forage by injurious rodents, instituted in the spring of 1918 in several western States, notably Arizona and Colorado. By means of quadrats established on grazing areas, some of these plats being fenced and others unfenced, the damage inflicted by the rodents which abound there is measured. A preliminary report on the results of these investigations is in preparation. A department circular (No. 59) entitled "Field Studies of Mammalian Life Histories," which outlines the procedure to be followed in studying the habits of these important animals in order to obtain the best results, was issued in October.

BIG-GAME AND BIRD RESERVATIONS.

Federal big-game and bird reservations in charge of the Biological Survey are now 75 in number. Four are big-game preserves, 70 are bird reservations, and 1, the Niobrara, created as a bird reservation, is used for both birds and big game. Included in the number is a small bird reservation near Fort Myers, Fla., of two islands containing rookeries and breeding grounds of several species of herons, established by Executive order of July 1, 1920, and known as the Caloosahatchee bird reservation, in the river of the same name. On June 30, 1920, the big-game reservations contained a total of 427 buffalo, 384 elk, 60 antelope, and 27 deer, an increase in each species over last year. The total number of buffalo now in the Government's various herds exceeds a thousand head, of which about half are under the charge of this department.

The boundaries of the Niobrara Reservation were modified during the year by the inclusion of a narrow strip of bottom land on the west boundary along the Niobrara River. A bill affecting the boundaries of the Klamath Bird Reservation, approved on May 27, 1920, among other things authorizes the Secretary of the Interior to determine which lands are chiefly valuable for a bird preserve and which are chiefly valuable for agriculture, and to eliminate and open to settlement the agricultural areas. The measure is likely to result in the modification of the southern boundaries of the reservation and in the elimination of swamp lands, which, however, have not been utilized by the birds for several years.

During the summer an investigation was made by a representative of the bureau, in cooperation with the secretary of the American Bison Society, for the purpose of selecting a tract in eastern Oregon suitable for a refuge for sage grouse and antelope, and as a result one was selected east of Warner Lake and extending from Lake County, Oreg., to Washoe County, Nev. Some opposition to the

creation of this reservation having developed, reexamination of the project indicates that the area may be materially reduced without serious injury to the purpose for which it is intended.

The unusual drought of 1919 was responsible for several fires, particularly on the National Bison Range, in Wind Cave Park, and on the Klamath Bird Reservation. No serious damage was done on any of the big-game refuges, but on the Klamath Reservation the fires burned over a considerable area of tule land before they were extinguished by autumn rains.

BIG-GAME RESERVATIONS.

Winter Elk Refuge, Jackson, Wyo.—This reservation thoroughly justified its existence this year in saving the southern Yellowstone elk herd from practical extermination by starvation. Throughout the summer of 1919 a severe drought prevailed in the northern Rocky Mountain States, which prevented the growth of forage on the range and greatly reduced the output of hay. This was followed by an almost unprecedentedly long and severe winter, beginning with fierce snowstorms, which drove the elk out of the high mountains the last of October, and continuing until the end of April.

The hay crop for 1919 on the elk refuge, with hay held over from the previous year, made a total of about 850 tons on hand at the beginning of winter. The State game warden of Wyoming provided about 500 tons and a carload of cottonseed-oil cake. As it became necessary to feed elk on the refuge much earlier than usual, it was plain that unless more hay was provided the last months of winter would see the animals perish by thousands. The Secretary of Agriculture granted the Biological Survey authority to expend the sum of $45,000, if necessary, in the purchase of hay to meet this emergency. Owing to the urgent need of hay for stock, it was difficult to secure any for the elk, but early in January 573 tons were purchased, hauled 30 miles on sleds, and fed to the elk during the later months of winter, at a total cost of $36,271.50. This provided sufficient hay to feed until the end of the emergency, April 20. About 8,000 elk were reported as having been fed on the refuge and in the valley below during a considerable period late in the season. The availability of the necessary hay to feed the animals at this critical time kept them off the winter range in that district, leaving the scanty forage on it to maintain the elk which did not descend to the feeding grounds.

Early in the fall it was estimated that there were about 17,000 elk in the southern herd, of which approximately 2,000 were killed by hunters. About 15,000 entered the winter, and a careful estimate gives 13,000 as the number of survivors which were doing well late in May. The loss of approximately 2,000 during the winter of 1919–20 was only a little above normal despite the severity of the winter and the scantiness of forage.

In connection with the maintenance of the elk on the Winter Elk Refuge it may be stated that the hay crop for 1919 amounted to only 314 tons, which was grown, cut, and stacked at an average cost of $4.09 a ton. This is a higher cost than the average in ordinary seasons, owing to the scanty crop caused by the drought. Hay land added to that on the refuge sufficient to raise the total yield in ordinary seasons

to from 1,000 to 1,200 tons would provide a surplus sufficient to meet any emergency and insure the perpetuation of the southern elk herd. It is imperative if the interests of the southern herd are to be reasonably safeguarded that additional hay land adjoining the present refuge be purchased at an early date.

National Bison Range, Moiese (near Dixon), Mont.—During the past year substantial improvements were made at the National Bison Range, including the construction of a residence for an assistant warden. At certain times of the year, particularly during the months when there is danger from fires, it is essential to have an assistant warden regularly employed on the range, and at other times extra assistance is necessary to enable the warden to perform his duties efficiently. Owing to the drought of 1919 unusual pressure was brought to bear on the department to open up part of the range for grazing, but on account of the danger of communicating cattle diseases to the buffalo it was considered unwise to assume the risk of jeopardizing the herds for which the range was established. Grass fires in August and September at first threatened to do considerable damage, but through the activity of the warden and the assistance furnished by the Reclamation Service and the Indian Agent they were extinguished after a few hours with only slight losses. A fire in the first week in August burned over about 1,000 acres.

The animals on the range now number nearly 600 head, as follows: Buffalo, 332; elk, 200; antelope, 40; and mule deer, 19. The herd of buffalo is now the second in size belonging to the Government and is fourth in point of numbers of those in the United States. The antelope show only a slight increase, but the losses have been smaller than in the previous year and it is hoped that the herd will increase more rapidly. Arrangements were made to secure a few white-tailed deer, and efforts will be continued during the coming year to establish a small herd on the reservation.

Wind Cave National Game Preserve, S. Dak.—The inclosure of 4,160 acres on this reservation now contains about 60 buffalo, 105 elk, 20 antelope, and 2 deer. As in the case of the Montana range and the elk refuge, the past winter proved unusually severe, but the losses were slight. The number of antelope remains about the same as last year, the natural increase being unfortunately offset by the loss of 7 animals.

It is highly desirable that the boundary lines on the north and west of the game preserve be modified by the addition of a small area in the adjoining national forest in order to straighten the lines and provide for future permanent boundary fences before the land becomes alienated or settled. Shelters, benches, tables, and other conveniences should also be provided for the comfort of visitors who wish to eat lunch or spend the day at the game preserve.

Sullys Hill Game Preserve, N. Dak.—Substantial progress has been made during the year in the improvement of this reservation, including the approval of plans for the construction of a women's rest house and for covered pavilions for protection during sudden storms. Plans for the extension of automobile roads from Devils Lake contemplate the construction of a road through the park immediately adjoining the lake shore. In case this improvement is consummated, the preserve will be readily accessible by automobile

or team from Devils Lake and undoubtedly the number of visitors will be greatly increased. This reservation is becoming increasingly popular among the people of the surrounding region and the improvements being made there will add much to their comfort. The herd of seven buffalo, the nucleus of which was presented by the Portland City Park, has done remarkably well considering the change in climate; besides these animals there are on the preserve 32 elk and 6 deer, an increase of 10 over last year.

Niobrara Reservation, Valentine, Nebr.—As already stated, the boundaries of this reservation were modified during the year by the addition of a strip which will afford protection to grouse and other birds. There are now in the inclosure 28 buffalo and 47 elk, 2 mule deer, and 4 Canada geese.

During the past winter a serious menace to the reservation developed in the leasing of four private holdings within the reservation boundaries and of the school section in the central part to certain interests which insisted on pasturing sheep and driving them to and from the river for water. This school section, belonging to the State, was leased for sheep grazing and a large flock of sheep was pastured there for some weeks, causing considerable destruction of the forage and expense to the department. Negotiations are now under way with the State authorities whereby it is hoped that danger of further grazing on the school section can be eliminated, but so long as the four private holdings remain within the boundary lines, there will be danger of a recurrence of the trouble. Plans are under consideration to increase accommodations for visitors and thus add to the public usefulness of this reservation.

BIRD RESERVATIONS.

On 13 of the 70 bird reservations paid warden service was maintained throughout the year, viz, Key West, Mosquito Inlet, Pelican Island, and Passage Key, Fla.; Minidoka, Idaho; Breton Island, La.; Big Lake, Ark.; Cold Springs, Klamath Lake, and Lake Malheur, Oreg.; Belle Fourche, S. Dak.; Strawberry Valley, Utah; and on the Hawaiian Islands Bird Reservation. On several other reservations warden service was maintained during the nesting period, the hunting season, and at other times when trespass was liable to occur. Through cooperation of the Reclamation Service protection is afforded on the more important of the bird reservations located within reclamation projects. Cases of trespass during the year have been comparatively few, the more important occurring on Big Lake and at Mosquito Inlet. Several arrests were made and convictions were secured in most cases.

Mosquito Inlet Reservation, Fla.—On the Florida reservations conditions have been most satisfactory at Mosquito Inlet, on the east coast. An interesting feature of this reservation is the recent voluntary establishment of a heron rookery within the limits of the town of New Smyrna, where the first birds nested in the spring of 1918. This year reports indicate the presence of several thousand young and old birds all in good condition. The colony is well protected and bids fair to become within a few years one of the important heron rookeries of the State. An unusual number of pelicans were noticed about the reservation during the winter of 1919–20, possibly due

in part to unsatisfactory breeding conditions at Pelican Island, a few miles farther south. A typical case of violation of the act protecting birds on bird reservations occurred on December 14, 1919, when a yacht passed through the reservation bearing three nonresident sportsmen who wantonly shot a number of gulls, terns, and pelicans. One of the offenders was subsequently arrested at Miami, warrants were obtained for the other two, and the case was set for trial at the next term of the Federal court at Jacksonville. This act of vandalism occurred within sight of a large sign warning against shooting on the reservation; such acts occur occasionally, but each instance has been followed by prompt arrest and conviction.

Pelican Island Reservation, Fla.—The birds on Pelican Island arrived August 13–14, earlier than usual. Eggs were laid in the first week in September, but a storm on the 28th destroyed most of them. The first young were hatched during the last week of October, but storms and high water on November 17–18 practically swept the island clear of all but a few nests, only those on the higher parts escaping, and these were later abandoned. Later unfavorable conditions in February were followed by an abandonment of the nests about March 1. Thus the season which began a month earlier than ordinarily was peculiarly unfavorable and fewer birds than usual were reared.

Passage Key Reservation, Fla.—Two large observation towers were erected on Passage Key at the mouth of Tampa Bay by Army engineers during the spring of 1920 in the only grove of mangroves on the island, and the tops of the trees were cut off and the nesting birds disturbed and driven away. The construction of these towers proved so detrimental to the interests of the reservation that arrangements have been made with the War Department to prevent future occurrences of this sort. Passage Key has suffered severely during the last few years from erosion and the effects of tropical storms. The island is now less than half its original size, but still includes the breeding grounds of gulls, skimmers, least terns, and several species of herons. Every effort is being made to afford the birds protection on the limited area now available for nesting sites.

Tortugas Keys Reservation, Fla.—A severe hurricane which visited the reservation in September did considerable damage both to the warden's quarters and to the birds. A lean-to kitchen was completely demolished, the porch and other parts of the headquarters damaged, and the warden himself had a narrow escape from serious personal injury. After being marooned on the island for three days, practically without food, he was rescued by the naval tug from Key West. Many of the birds were overwhelmed by the storm, but it is impossible to ascertain the exact number. Warden service was reestablished in June, and arrangements have been made for necessary repairs to the quarters. The number of terns on this reservation has increased to a point where it will be necessary, after the breeding season is over, to provide further nesting sites and material by planting bay cedars. These bushes were formerly numerous on the island, but many of them were destroyed some years ago by storms and high water.

Big Lake Reservation, Ark.—The location of proposed drainage canals on the north and east sides of this reservation has been ad-

justed in a way which, it is hoped, will prevent damage to the reservation in the course of the development of the adjoining drainage districts. Owing to the unusual depth of water during the past winter, mallards and other ducks did not remain in as large numbers as usual, but with the lowering of the water the birds are likely to return next year in their usual numbers. Poaching has been less frequent, and the establishment of regular warden service and the enforcement of the law have resulted in general acceptance of the restrictions necessary for the maintenance of the reservation.

Klamath Lake Reservation, Oreg.—Conditions on the Klamath Lake Reservation have been very unsatisfactory, owing to a combination of circumstances over which this department has had no control. The tule fire, which was started in the spring of 1919, continued to burn over the southern part of the reservation until extinguished by early autumn rains, and a considerable area inside the boundary lines was rendered unfit either for occupation by the birds or for immediate agricultural use. The water table on the lake has been lowered several feet by closing the gates which control the inflow from the Klamath River. This action, made under agreement with the water users' association, has uncovered large areas of alkali mud flats without thus far benefiting the settlers adjoining the lake or opening up additional lands suitable for agriculture. A soil survey made during the summer of 1919 has shown that the lands thus uncovered have little, if any, agricultural value. The act authorizing the elimination of certain agricultural lands from the reservation, recently approved, should result in determining the permanent boundaries of the reservation. If an agreement can be made for raising the water level slightly, Klamath Lake can still be made one of the most important bird reservations in the West; otherwise its future as a refuge is seriously jeopardized.

Malheur Lake Reservation, Oreg.—Conditions at Malheur Lake have been as unsatisfactory as those at Klamath. The unusual drought which prevailed in eastern Oregon in 1919 caused the lowering of the water level and the diminution of the breeding grounds of the birds. The uncertainty of the title to some of the lands adjoining and within the boundary lines of the reservation seriously impedes any effective development. Some action is imperative to clear up the question of jurisdiction and enable the department to fix a stable water level and develop the reservation in a way to afford protection to the birds.

The most serious menace to this great breeding place for wild fowl lies in the appropriation of water, heretofore flowing into the Malheur Lake basin through the Silvies and the Blitzen Rivers, for the development of agricultural lands at a distance from the lake. This has already reached a point which leaves the future of the lake very doubtful. The constant diversion of this water supply means the drying up of the lake and the reduction of its basin to a bare alkaline mud flat like that now marking a large part of the Harney Lake bed. When this occurs it will make absolutely worthless the near-by forage-producing lands now growing natural feed with a substantial income on a valuation of $1,000,000, and will leave the residents homeless.

A soil survey made of the lands about the borders of the lake during the summer of 1919 by an expert from the Bureau of Soils developed the fact that they are too strongly charged with alkali to have any agricultural value other than the production of the natural forage crop.

Hawaiian Islands Reservation.—Renewed requests have been received for permission to establish fishing stations on some of the islands of this reservation, but it is obvious that this would result in the practical extermination of the bird life which this reservation was established to protect. The bureau is strongly averse to any such occupation of these islands.

MIGRATORY-BIRD TREATY AND LACEY ACTS.

PROTECTION OF MIGRATORY BIRDS.

The constitutionality of the migratory-bird treaty and the act of July 3, 1918, to give it effect was sustained on April 21, 1920, by decision of the Supreme Court of the United States in the case of the State of Missouri *v.* Ray P. Holland, United States game warden, an action brought to restrain Federal wardens from enforcing the Federal law in Missouri. An application by the State of Missouri for a rehearing was denied on June 7, 1920. Six Federal judges—in Arkansas, Florida, Louisiana, Missouri, Montana, and Texas—had previously upheld the validity of the act.

During the year the number of United States game wardens was increased from 15 to 31, but the warden force is still far below the number needed for the effective enforcement of the law. At various times during the year it became necessary to place on active duty 65 deputy wardens, who rendered valuable services and greatly assisted in reducing violations. Cooperation was also extended by 245 deputy wardens, who received a nominal salary of $1 per annum; these Federal deputies in most instances occupy positions as State deputy game wardens.

Owing to the small number of wardens, it became necessary during the spring migration to concentrate the force in the Middle Western and South Atlantic Coast States, where violations were most numerous, and as a result of these concerted efforts many violators, including some who had for a long time successfully evaded detection, were apprehended.

United States game wardens and deputies reported 537 violations; 423 convictions were secured, in which fines were assessed ranging from $1 to $500 and aggregating more than $8,900. In the large majority of cases the fines were supplemented by the imposition of costs, which in most instances equaled, and in others exceeded, the amount of the fines. Five cases were dismissed by Federal judges; 56 cases were nolle prossed; grand juries returned no bills in 56 cases; 2 trials by juries resulted in acquittals; 2 prosecutions were terminated by death of defendants; and 8 prosecutions were abandoned by United States attorneys because of insufficient evidence. Twenty-eight cases of trivial or technical character were not reported by the bureau for prosecution.

Convictions were secured in Federal courts as follows: Alabama, 4; Arizona, 2; Arkansas, 44; California, 1; Connecticut, 1; Delaware, 2;

District of Columbia, 3; Florida, 28; Georgia, 18; Illinois, 28; Iowa, 16; Kansas, 1; Kentucky, 17; Louisiana, 28; Maine, 2; Maryland, 35; Massachusetts, 1; Michigan, 3; Minnesota, 20; Mississippi, 3; Missouri, 27; Montana, 5; Nebraska, 18; Nevada, 1; New Jersey, 31; New York, 10; North Carolina, 6; North Dakota, 1; Ohio, 4; Rhode Island, 5; South Carolina, 2; South Dakota, 10; Tennessee, 3; Texas, 26; Virginia, 5; Washington, 7; and Wisconsin, 5.

A libel proceeding against 5,736 reedbirds was filed in the Supreme Court of the District of Columbia, and by order of the court the birds were given to the Walter Reed Hospital for use as food. Five libel proceedings against aigrettes were had in Alabama and the plumes condemned by court order.

Plumes of migratory birds, of an estimated value of $12,500, possessed, offered for sale, or sold in violation of the law, were seized during the year. Some of these were released to the bureau by the parties from whom seized, while others were turned over to it by court order. Numerous seizures were made of migratory game birds illegally killed or possessed, and most of such birds have been disposed of by the bureau, with the consent of the person from whom seized, by gift to hospitals and charitable institutions for use as food.

In many cases substantial fines have been imposed, but in others the convicted parties have been given their freedom on payment of nominal fines. One persistent offender, charged with transporting quail and other game birds from Massachusetts to New York, but which were seized in transit at New Haven, Conn., was convicted and sentenced to 3 months in jail. A violator charged with unlawfully collecting eggs of migratory birds was arraigned in the Federal court for the eastern district of South Carolina and fined $30 and costs, and in addition sentenced to one week in the Charleston County jail. In Michigan in 2 cases involving the purchase and sale of wild ducks fines of $250 and $500 were imposed; in Florida in 2 cases involving the possession and sale of aigrettes, each violator was fined $250, and the plumes, worth several thousand dollars, were confiscated and condemned; one offender arraigned in Federal court at Sioux Falls, S. Dak., charged with selling wild ducks, was fined $200; while one arraigned on a similar charge at Baltimore, Md., was fined $250 and costs. A case involving hunting and killing geese in close season resulted in a fine of $100 in the Federal court in New Jersey; the offender in this case was convicted in Federal court last year and fined $5, but at the trial for the second offense he was warned by the judge that another repetition would merit a jail sentence. At Milwaukee, Wis., the Federal judge imposed fines of $100 each against 3 persons charged with shooting wild ducks after sunset. Many fines ranging from $25 to $100 were also imposed by judges in other States.

The airplane also had its place in the pursuit of game, and as a result of resort to this illegal means of hunting migratory game birds five violators were apprehended, one of whom has been convicted and fined $50 in Federal court at Sioux Falls, S. Dak., this being the first conviction under the Federal law for a violation of this character; the other four cases are still pending.

Several prosecutions on charges of hunting from motor boats resulted in convictions and the imposition of substantial fines. One person charged with hunting from a motor boat entered a demurrer

on the ground that the Federal law was unconstitutional, but the demurrer was overruled and a fine assessed.

Very gratifying reports are still being received from nearly every section of the country of the ever-increasing number of migratory birds as a result of Federal protection. Sportsmen enjoyed the best hunting season of many years, and in a large number of sections the daily bag limit was easily secured. It is particularly gratifying, especially to the sportsmen of the Middle West, to know that sandbar shooting in the Mississippi River, long since destroyed by hunters operating from motor boats, has been restored as a result of the ban placed on motor-boat hunting.

During the year 783 persons were authorized to collect and 92 persons were authorized to possess migratory birds for scientific purposes, 58 persons were authorized to capture and 1,343 persons were authorized to possess migratory waterfowl for propagating purposes. Only a small percentage of the persons to whom propagating permits were issued are engaged in breeding waterfowl for food purposes, many of the birds possessed being held merely for use as decoys or for ornamental purposes.

In New Jersey the game law was made to conform to the Federal regulations, and in Kentucky laws were enacted in conformity with the Federal regulations with respect to the open seasons for waterfowl and Wilson snipe, the bag limits on all species of migratory birds except plover and yellow-legs, and the provisions prohibiting hunting between sunset and half an hour before sunrise. The seasons for waterfowl and most other species of migratory birds now substantially conform to the Federal regulations in 30 States.

On October 4, 1919, an order was issued by the Secretary of Agriculture permitting meadowlarks to be killed in South Carolina when necessary to protect grain crops. Other orders were issued as follows: On October 24, 1919, permitting certain species of birds to be killed at fish hatcheries when found to be injurious to fish life; on July 30, permitting rice growers and members of their immediate families and bona fide employees in the counties of Butte, Colusa, Glenn, Sutter, Yolo, and Yuba, Calif., to kill wild ducks when necessary to protect the rice crop from the depredations of such birds; and on November 13, a similar order applying to the counties of Arkansas, Lonoke, and Prairie, in Arkansas; on March 30, 1920, relating to the issuance of permits effective in New York when countersigned by the State Conservation Commission, allowing the killing of robins when necessary to protect the cherry crop; on April 29, permitting the killing or trapping by State game wardens in Michigan of certain birds found to be injurious to valuable fish life; and on the same date a similar order authorizing State game wardens of New Hampshire to kill or trap certain birds on streams closed to fishing.

During the early part of 1920 it became evident that certain amendments of the migratory-bird treaty act regulations were needed. These were formulated in the bureau, and together with other matters relating to game conservation were considered by the Migratory-Bird Treaty Act Advisory Board which met in Washington on June 21 and 22. The opportunity for the personal exchange of ideas between officials of the bureau and the advisory board proved to be so advantageous that it was planned that, if practic-

able, a meeting of the board should be held annually to consider matters bearing on the maintenance of the supply of wild fowl and a perpetuation of wild fowl hunting throughout the country.

The Biological Survey continues to receive the friendly cooperation of a great number of State and local organizations and individuals, which adds immeasurably to the effectiveness of its work. It is fortunate that this is so, for without the good will of the State game and conservation commissioners and of organizations and individuals interested in bird conservation, efforts to administer the migratory-bird treaty act and to promote general conservation would be seriously hampered. The assistance of such organizations as the Boone and Crockett Club, the American Game Protective Association, and the National Association of Audubon Societies is invaluable in this work. For years the last-named organization has contributed annually considerable sums of money to aid the conservation work of the bureau; in the spring of 1920 it spent $1,600 in the payment of warden service in Florida for the protection of egret colonies under the supervision of Federal wardens. Through the cooperation of these organizations and of State game commissioners and sportsmen, a healthful sentiment for game conservation has been created in many sections where formerly the people were not favorable to Federal protection of migratory birds.

INTERSTATE COMMERCE IN GAME.

Interstate commerce in wild animals and parts thereof is regulated by sections 242, 243, and 244 of the Penal Code, commonly referred to as the Lacey Act. Special efforts have been made to complete investigations of a large number of shipments uncovered during the last fiscal year, in addition to investigating current shipments which seemed to have greatly increased owing to the high prices of furs now prevailing.

Twenty-six violations have been reported to the solicitor of the department, involving shipments of 233 beaver, 4 otter, 125 deerskins, 1,634 pounds of deerskins, a miscellaneous lot of moose and deer hides, 1 deer, 568 quail, and quantities of aigrettes.

During the year 22 convictions were secured, in which fines amounting to $1,070 were imposed; 6 cases were dismissed because of insufficient evidence; 3 were stricken from the docket; and 1 case was terminated by death of defendant.

The completion of investigations of a large number of other shipments disclosed no violations of the Federal law, as they were not made by common carrier or else involved animals or parts thereof shipped in accordance with State laws. Many cases of shipments made in violation of State laws were turned over to appropriate State authorities for prosecution when it was thought the best results could thereby be obtained. Through this cooperation the States not only collected many thousands of dollars in fines and penalties, but were better enabled to keep in close contact with shippers and thus to discourage violations of the law. One hundred and thirty-one shipments are still under investigation.

Cases reported for prosecution originated in the following States: Colorado, 2; Idaho, 1; Illinois, 2; Iowa, 1; Minnesota, 2; Missouri,

1; New Hampshire, 1; New Mexico, 2; New York, 1; North Carolina, 1; Oregon, 7; Tennessee, 1; Utah, 1; Washington, 2; Wisconsin, 1.

At the request of the bureau many of the large fur dealers are republishing in their catalogues and advertising material information furnished by the department concerning State trapping and shipping laws and are omitting from their price lists quotations on furs of animals for which no open season is provided.

1920

IMPORTATION OF BIRDS AND MAMMALS.

The number of permits issued during the year showed an increase of 66 per cent—from 273 in 1919 to 453 in 1920—and the number of inspections from 42 to 89. The permits issued for the entry of foxes from Canada showed a total of 805 as compared with 335 in 1919. At Honolulu permits were issued for the entry of a few birds, including pheasants and several miscellaneous cage birds. So far as known no prohibited species were entered during the year.

The resumption of importations of foreign birds from European ports has increased slowly. Shipments of canaries from Germany have begun, but only in small numbers and by no means sufficient to meet the holiday trade. A few Indian and African consignments have reached New York, some of them by way of England. At San Francisco shipments from the Orient, particularly from Australia, have shown a steady increase. Large numbers of Lady Gould finches, both black and red-faced, have been received, and also many rare and interesting birds, including two gray-headed geese (*Chloephaga poliocephala*) from southern South America, four African ducks (*Anas undulata*), four Cabot tragopans (*Tragopan caboti*) from southeastern China, two satin bower birds (*Ptilorhynchus violaceus*) from Australia, a green barbet (*Thereiceryx zeylanicus*) and eight white-eared hill tits (*Mesia argentauris*) from India, a short-tailed parrot (*Graydidiseulus brachyurus*) from Brazil, two gray-winged trumpeters (*Psophia crepitans*) from British Guiana, and a number of Siberian goldfinches and other species imported for exhibition purposes.

Shipments from South America have not increased as much as might have been expected, although some birds have been received from Colombia, Venezuela, and Brazil. The prevailing rates of exchange, which have been unfavorable in several South American countries, have had an important bearing in limiting shipments by importers who are accustomed to outfit traveling representatives in foreign countries.

IMPORTATION OF QUAIL FROM MEXICO.

The regulations governing the importation of quail from Mexico were modified under date of September 18, 1919, to provide an open season from November 15 to March 31, and a port of entry was established at Brownsville, Tex. Under date of March 15, 1920, the open season was extended 10 days, to April 10. Through the cooperation of the Bureau of Animal Industry arrangements for inspection and quarantine were provided at the three ports of Browns-

ville, Laredo, and Eagle Pass, Tex. The number of quail entered from Mexico was 24,337, but the number released from quarantine was 23,473. Quail disease appeared among the birds entered at Eagle Pass and Laredo. Entries were suspended at Eagle Pass for three weeks, and after March 9 no further importations were made. At Laredo no entries were received in quarantine during the investigation of the presence of the disease. At Laredo 253 birds died during the quarantine and 59 at Eagle Pass, but at the latter point 540 birds, many of them infected with quail disease, were returned to Mexico. On the whole, more quail were imported than for several years past, but in spite of the long season and the special facilities provided for entry and quarantine, the results were not altogether satisfactory. Several reports received by the department indicate that a number of the birds died after reaching destination, and in one case a large proportion of the birds ordered by one of the State commissions late in the season died within a few days after arrival.

Importations of quail from Mexico began about 1910, and during the 10 years that entries have been made the total number imported, including entries of the present year, was approximately 92,000, of which about 56,000 were brought in during the seasons of 1917 and 1920. The success of these importations as a whole is exceedingly doubtful and those contemplating future importations should study the outcome of previous importations to avoid as many detrimental factors as possible.

CONSERVATION OF MARSH AREAS.

For two years the Biological Survey has made a special effort to draw the attention of all sportsmen, including State game commissions, to the menace to the future of our migratory wild fowl through the drainage of small lakes and swampy areas on a constantly increasing scale. The appreciation of the situation is becoming general and it is hoped that effective steps may be possible whereby the Federal and State Governments may secure permanent title to a number of such areas to be maintained in perpetuity as bird preserves. The greater number of these preserves should be guarded as sanctuaries during the breeding season and be maintained as public hunting grounds for the benefit of all citizens during the open season. A small number should be held as sanctuaries throughout the year to serve as reservoirs to supply other areas with wild fowl. Before the drainage of such water areas is undertaken it would be desirable to have experts make a careful survey and report on the relative value of each area for agricultural purposes and, in its natural condition, as a producer of wild fowl, furs (muskrats, etc.), fish, and ice, and as a public recreation ground whereby out-of-door sports may be maintained and the health and well-being of the citizens promoted. Other important uses for lake and marsh areas in many places are the maintenance of the normal underground water level, affecting springs, wells, and vegetation, often at considerable distances, and the prevention of erosion by delaying the run-off of flood water.

REINDEER INDUSTRY AND FUR BEARERS OF ALASKA.

In the appropriation act approved May 31, 1920, for the fiscal year ending June 30, 1921, provision was made for the Biological Survey to investigate the reindeer industry in Alaska with a view to its development. At the same time the administration of the laws protecting the land fur-bearing animals of Alaska was transferred from the Bureau of Fisheries in the Department of Commerce to the Biological Survey. During June, 1920, the services of an experienced pathologist and veterinarian and two men experienced in grazing investigations in the Forest Service were obtained for the purpose of acquiring basic information needed for the furthering of the reindeer industry. An experiment station will be established as soon as possible after the beginning of the fiscal year 1921, at some point on the coast of Bering Sea. A naturalist will spend the year investigating the caribou herds of Alaska to obtain information which will be useful in this work. The enormous area occupied by the land fur-bearers of Alaska, which are being seriously overtrapped, renders their protection exceedingly difficult. However, a warden service will be established and so far as possible with the limited funds available the Alaskan fur-bearers will receive protection.

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